A NOTE ON MR. MITCHELL'S PAPER ON WEST INDIAN HURRICANES

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Concerning the disturbances originating at the beginning and particularly at the end of the hurricane season over the western Caribbean Sea and Gulf of Mexico, Mr. Mitchell makes the statement that a large percentage of them reach high latitudes before dissipating. Are they not, to use Mr. Bjerknes's expression, E or F members of the cyclone family?

Mr. Mitchell, as his paper shows, collected a great amount of material that he used for charting the tracks of tropical cyclones and he could probably ascertain for each cyclonic track the approximate date of the start of the cyclonic whirl. Such data would be of value. The study of Weather Bureau charts for the United States for days previous to that date would show whether the "starter" does not enter into the Tropics from outside, from the Temperate Belt, for instance, as a strong cold wave proceeding farther south as a norther. (The statistics of cold waves in the United States are known from the late Mr. Garriott's paper.) The occurrence of northers in the locality, just before the appearance of hurricanes there would show the West Caribbean and Gulf hurricanes to be the last members of the cyclone family that is developing along the proceeding front of this polar air. These hurricanes, shifting to the higher latitudes, arrive, then, on the western European coast, say, as B or C cyclones.

Though suggesting this correlation of cold waves and northers with Caribbean and Gulf hurricanes, I will, however, not claim that the starter of each tropical cyclone must come from outside of the Tropics. It is well known that tropical cyclones are comparatively rare phenomena, certainly much rarer than the polar air entering the Tropics, as the scheme of general circulation according to Mr. Bjerknes shows.

DISCUSSION

The suggestion of Doctor Hanzlik that tropical cyclones originating in the western Caribbean and the Gulf of Mexico may be the last members, E or F, of a cyclone family that is developing along the polar front, is doubtless a natural one to make by one familiar with the development and movement of cyclones in groups or families as in Europe. In North America, as pointed out by Henry (MO. WEA. REV., 50:473), cyclones do not develop and move in families, and moreover, in the months of June to September there is little or no evidence of the movement of surface air from polar regions; in other words, polar air in those months is practically nonexistent so far as the Gulf of Mexico and the Caribbean are concerned. For this reason, and on account of the rarity of cyclonic development in this region in July and August, the cyclones of these two months are not considered in the tabulation which will be presented below.

The sweep of polar air southward over the Gulf of Mexico does not begin until late October and is not pronounced until still later in the cold season. However, I have made an examination of the daily weather charts for the three days preceding and the three days following the origin of West Indian hurricanes. The criterion adopted to show the arrival of polar air in these regions was the advance of an area of high pressure and cooler air southward over the Plains States and Texas, accompanied by a norther over the western Gulf of Mexico. Experience has shown that fresh northerly winds on the Texas coast with a pressure distribution of that character means strong northerly winds farther south, especially in the Tampico and Vera Cruz regions of Mexico.

Relation of tropical cyclones to northers in the western Caribbean Sea and Gulf of Mexico

Cyclones preceded by northers over western Gulf of Mexico one to three days previous to development of cyclonic whirl:

Oct. 8, 1888 (1 day before).	Oct. 9, 1906 (3 days before).
Oct. 6, 1891 (1 day before).	Oct. 25, 1908 (2 days before).
Oct. 2, 1895 (1 day before).	Oct. 2, 1912 (2 days before).
Oct. 13, 1895 (1 day before).	Oct. 22, 1923 (2 days before).
Oct. 9, 1900 (1 day before).	Nov. 11, 1916 (2 days before).
Oct. 7, 1902 (3 days before).	Total, 11.

Cyclones followed by northers same day to two days after development:

Oct. 9, 1887 (2 days later.)	Oct. 27, 1913 (same day).
Oct. 5, 1889 (1 day later).	Oct. 10, 1916 (same day).
Oct. 21, 1892 (2 days later).	Nov. 5, 1893 (same day).
Oct. 7, 1896 (same day).	Nov. 11, 1904 (same day).
Oct. 11, 1912 (1 day later).	Total, 9.

Cyclones neither preceded nor followed by northers (within two or three days):

June 10, 1889.	Sept. 28, 1895.	Oct. 3, 1905.
June 15, 1889.	Sept. 11, 1912.	Oct. 17, 1908.
June 12, 1895.	Sept. 1, 1915.	Oct. 6, 1909.
June 10, 1901.	Sept. 19, 1920.	Oct. 11, 1910.
June 11, 1902.	Sept. 27, 1920.	Oct. 24, 1914.
June 19, 1902.	Sept. 6, 1921.	Oct. 21, 1921.
June 7, 1906.	Oct. 7, 1886.	Oct. 12, 1922.
June 12, 1906.	Oct. 29, 1887.	Oct. 14, 1922.
June 25, 1909.	Oct. 20, 1893.	Oct. 13, 1923.
June 26, 1909.	Oct. 1, 1894.	Nov. 6, 1906.
June 7, 1912.	Oct. 2, 1899.	Nov. 8, 1909.
June 22, 1913.	Oct. 26, 1899.	Nov. 22, 1909.
June 15, 1921.	Oct. 10, 1904.	Nov. 11, 1912.
June 13, 1922.	Oct. 29, 1904.	Total, 41.

Inasmuch as none of the June or September cyclones was either preceded or followed by a norther over the western Gulf of Mexico, the advent of polar air in the Tropics can not be regarded as even a contributing cause of the storms of those months. Moreover, only 10 of the 34 October and 1 of the 7 November cyclones were preceded by northers, so that the advent of polar air could have been a factor in the development of only 11 of the 61 tropical cyclones considered.

On pages 16–17 of SUPPLEMENT NO. 24, MONTHLY WEATHER REVIEW, is a discussion of the two principal regions where tropical cyclones develop in the North Atlantic Ocean. On page 17 it is stated:

> Over the western third of the Caribbean Sea, especially in the region a short distance north of the Isthmus of Panama, a belt of doldrums appears at times, especially at the beginning and near the end of the hurricane season. This, quite likely, is the extreme eastern end of the Pacific belt of doldrums, which is usually just south of the Isthmus of Panama, * * * and which has shifted northward beyond latitude 10° N. Thus conditions in the western Caribbean Sea at these times become as favorable for the development of a cyclonic disturbance as they are in the region south of the Cape Verde Islands in the months of August and September.

The favorable conditions referred to are high temperature, high humidity, and a doldrum condition of light, variable winds, and these conditions must exist far enough north of the Equator so that in addition to the northeast trades north of the doldrums there shall be south of them the southeast trades which have crossed the Equator and become southwest winds due to the deflective effect of the earth's rotation. These, to me, seem the ideal conditions for the development of unstable, squally weather and the initiation of a cyclonic whirl in the lower atmosphere.—*C. L. Mitchell.*